

Fungi that entrap and assimilate nematodes employing
mucilaginous, hyphal, 3-dimensional traps

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A variety of both simple and complex morphological adaptations of hyphae are utilized by nematophagous fungi to entrap nematodes in the soil. One trapping mechanism found commonly in Florida soils is the mucilaginous, 3-dimensional, hyphal network trap. Such traps are characterized by mycelia winding and twisting through the soil, and in so doing numerous enclosures and protuberances are formed. The surface of the hyphae and inner surface of the enclosures are coated with a substance that adheres to the cuticle of nematodes which may pass through the enclosures or brush against the hyphae. Some hyphae produce an adhesive substance only at the point of contact. Of the 231 known species of fungi that prey on nematodes and other small invertebrates, 36 species (16%) in six genera form 3-dimensional, trapping networks (Table 1).

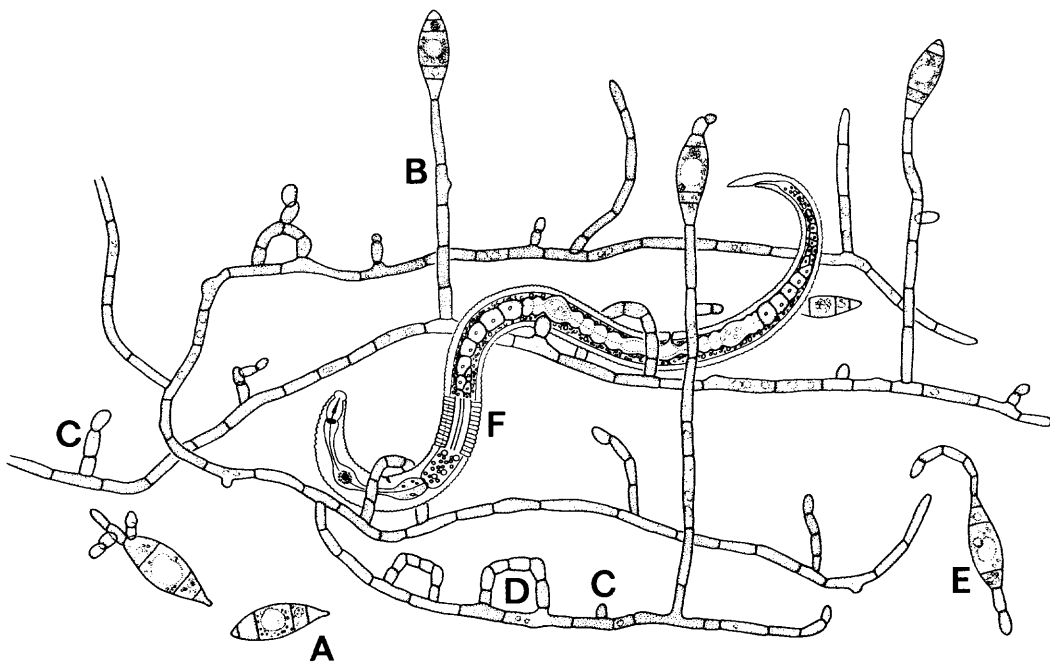


Fig. 1. A stunt nematode (*Tylenchorhynchus* sp.) caught in a 3-dimensional network trap of *Dactylella cionopaga*. A. conidium. B. conidiophore. C. protuberances. D. enclosure. E. germinating conidium. F. entrapped nematode.

HISTORY: W. Zopf, 1888 was first to note nematodes being trapped and killed in 3-dimensional, mucilaginous traps (6).

CHARACTERIZATION: In laboratory cultures the trapping network is initiated when a conidium germinates on water agar (Fig. 1-E), and produces a hyphal filament, or when a hyphal filament emanates from an infected host. In either case, the fungal germ tube grows across the agar surface, and in a few hours short protuberances form on the hyphae.

The protuberances grow, curl, and anastomose, to form enclosures (Fig. 1-D). When nematodes are abundant on the agar surface, one or more nematodes may touch the hyphal configuration and become entrapped in the early developmental stages of the network. Death occurs 1-2 hours after entrapment. In less than 12 hours the nematode bodies will become filled with hyphae, and many filaments and elements of the trapping hyphal network will be evident. In a few days several

very large islands comprised of a dense 3-dimensional, trapping network and many conidiophores (Fig. 1-B) bearing conidia will be present on the agar surface. Numerous bodies of dead and dying nematodes become enmeshed in the network. Trapping hyphae are so dense in the islands, one cannot easily envision a nematode safely venturing into or near the islands. In a large culture of pinewood nematode, Bursaphelenchus lignicolus Mamiya and Kiyohara, 1972, a trapping network of Arthrobotrys oligospora Fres. trapped and killed every nematode in the culture.

HABITAT: Leaf mould, decaying wood, plant residues, and dung are preferred habitats for the nematophagous fungi; however, the fungi are not found in extremely mineral soils or acid peats (2). In Florida, 3-dimensional, network trapping fungi have been found in many types of field soils and plant nursery soil mixes.

Arthrobotrys oligospora was recovered from dead slash pine tree tissue (Pinus elliotii Engelm.) in Florida, where it was trapping pinewood nematode.

PREY: Host selectivity has not been observed in host-fungus interactions. Any nematode that makes contact with the hyphae and becomes enmeshed is destroyed. In almost all taxonomic descriptions of the nematophagous fungi the host nematodes are bacteriophagus forms.

In cultures from Florida citrus soils, Dactylaria thaumasia Drechs. and Dactylella cionopaga Drechs. were observed trapping many citrus nematodes (Tylenchulus semipenetrans Cobb, 1913), (Fig. 2, left), and D. cionopaga has been observed killing Pratylenchus coffeae Zimmerman, 1898 and Aphelenchus sp. (Fig. 2, right).

BIOLOGICAL CONTROL POTENTIAL: The adhesive, 3-dimensional trap is considered very efficient, capturing more nematodes per unit area than any other kind of trap (5). Attempts to control cyst nematodes, Heterodera schachtii Schmidt, 1871 on beets (3) or H. rostochiensis Woll., 1923 on potatoes (4) using Dactylaria thaumasia were not successful. Arthrobotrys musiformis Drechs. was added to burrowing nematode-infected citrus groves but failed to reduce the nematode population (7). Nematode pests of mushrooms were effectively controlled and crop yields increased by adding Arthrobotrys robusta Dudd. to the mushroom beds (1).

SURVEY AND DETECTION: In a population of nematodes, infected members will appear off-color and sickly. Hyphae may protrude from their bodies. Such specimens placed on the surface of water agar will usually produce fungal fructifications and traps that will facilitate identification.

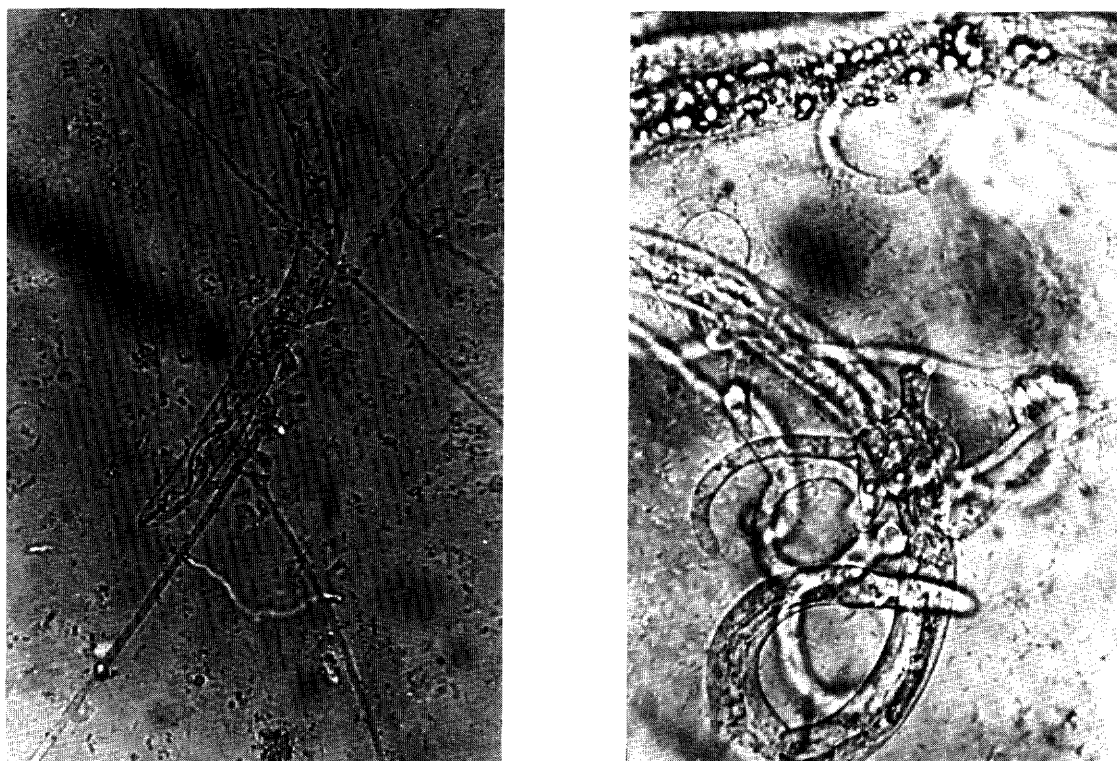


Fig. 2. Dactylella cionopaga. Left: Citrus nematode entrapped by early developmental stages of the fungus. Right: Aphelenchus sp. trapped by enclosures produced by the fungus.

Table 1. Fungi that produce 3-dimensional hyphal networks

MONILIACEAE (HYPHOMYCETES)

<u>Arthrotrrys anomala</u> Barron & Davison	<u>D. psychrophila</u> Drechs.
<u>A. arthrotrryoides</u> (Berl.) Lind	<u>D. pyriformis</u> Juniper
<u>A. cladodes</u> Drechs.	<u>D. scaphoides</u> Peach
<u>A. cladodes</u> var. <u>macroides</u> Drechs.	<u>D. thaumasia</u> Drechs.
<u>A. conoides</u> Drechs.	<u>D. vermicola</u> Cooke & Satchuthananthavale
<u>A. dolioformis</u> Sopr.	<u>Dactylella cionopaga</u> Drechs.
<u>A. drechsleri</u> Sopr.	<u>D. gephyropaga</u> Drechs.
<u>A. kirghizica</u> Sopr.	<u>D. megalospora</u> Drechs.
<u>A. longispora</u> Preuss	<u>D. reticulata</u> Peach
<u>A. musiformis</u> Drechs.	<u>Genicularia cytosporidia</u> (Dudd.) Rifai & Cooke
<u>A. oligospora</u> Fres.	<u>G. paucispora</u> Cooke
<u>A. oviformis</u> Sopr.	<u>G. perpasta</u> Cooke
<u>A. robusta</u> Dudd.	<u>Trichothecium flagrans</u> Dudd.
<u>A. superba</u> Corda	<u>T. globosporum</u> Sopr.
<u>Dactylaria clavispota</u> Cooke	<u>T. globosporum</u> var. <u>microsporum</u> Sopr.
<u>D. eudermata</u> Drechs.	<u>T. globosporum</u> var. <u>roseum</u> Sopr.
<u>D. gampospora</u> Drechs.	<u>T. pravicovi</u> Sopr.
<u>D. polycephala</u> Drechs.	

ZOOPAGACEAE (ZYGOMYCETES)

Stylopage hadra Drechs.

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